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Burchette

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(54) **REFILLED TONER CARTRIDGE HAVING INCREASED YIELD**

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G03G 21/18	(2006.01)
G03G 21/12	(2006.01)
G03G 15/08	(2006.01)

(52) **U.S. Cl.**

CPC ***G03G 21/181*** (2013.01); ***G03G 15/0894*** (2013.01); ***G03G 21/12*** (2013.01); ***G03G 21/1889*** (2013.01); *G03G 15/0834* (2013.01); *G03G 15/0863* (2013.01)

(58) **Field of Classification Search**

CPC G03G 15/0834; G03G 15/0863; G03G 15/0894; G03G 21/12; G03G 21/181; G03G 21/1875

USPC 399/109, 120, 360

See application file for complete search history.

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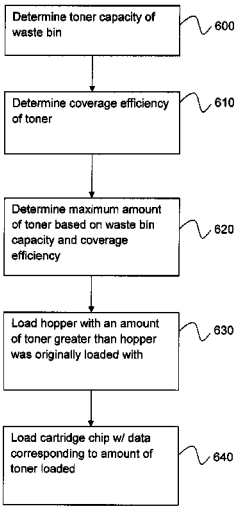
Primary Examiner — Benjamin Schmitt

(57) **ABSTRACT**

Electronic systems, such as printing systems, often use components that have integral memory. The integral memory can be used to store information about the component. In some printing systems this memory includes a portion that stores a value indicative of a print yield. Disclosed is a method and system for allowing the memory to have data indicative of an increased print yield.

8 Claims, 7 Drawing Sheets



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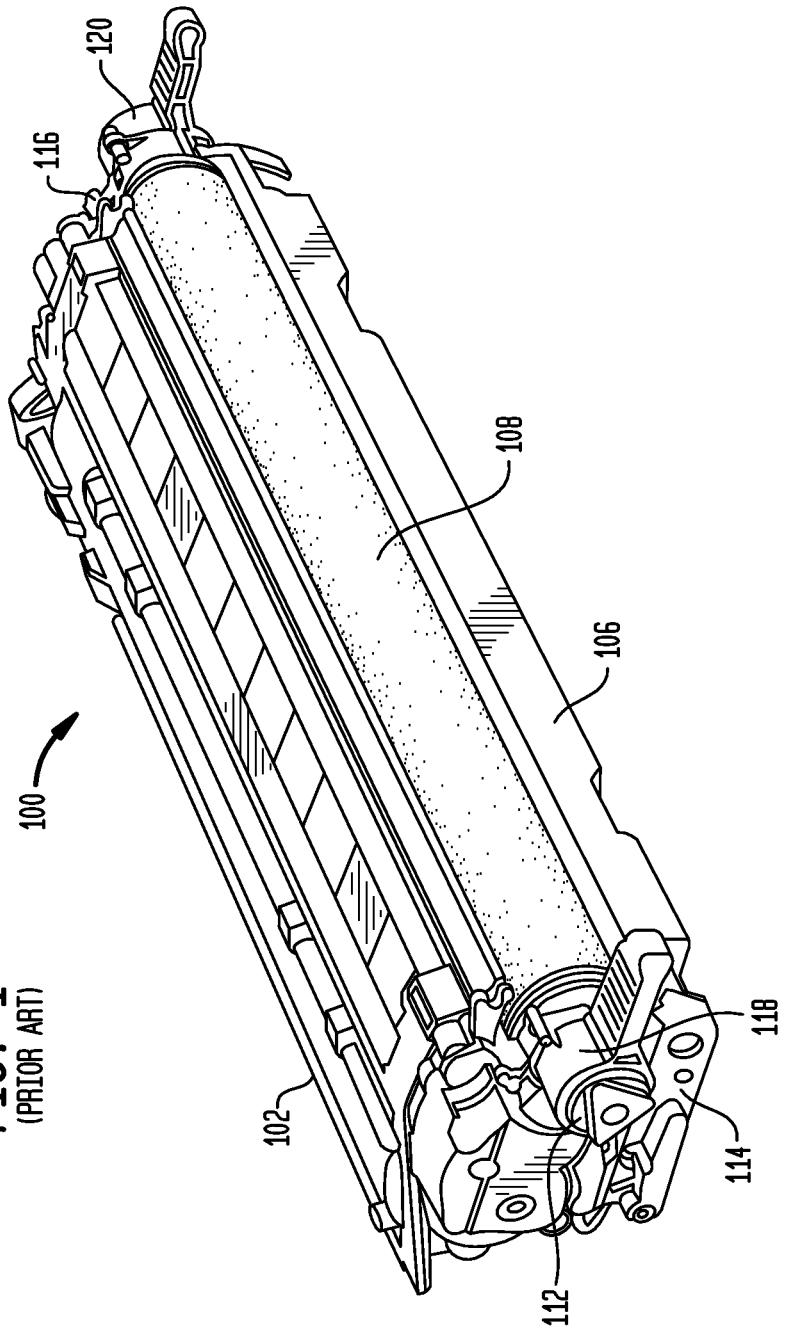

FIG. 1
(PRIOR ART)

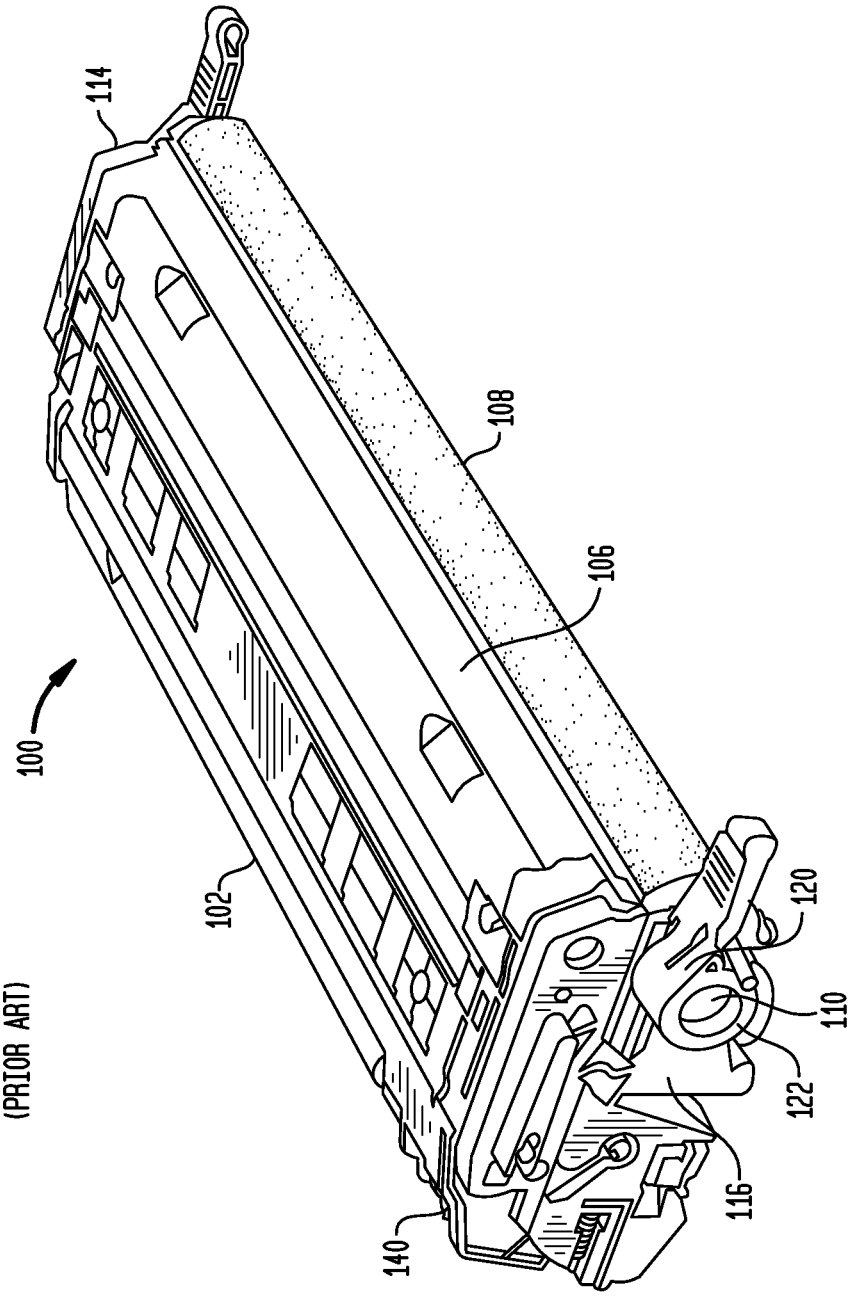

FIG. 2
(PRIOR ART)

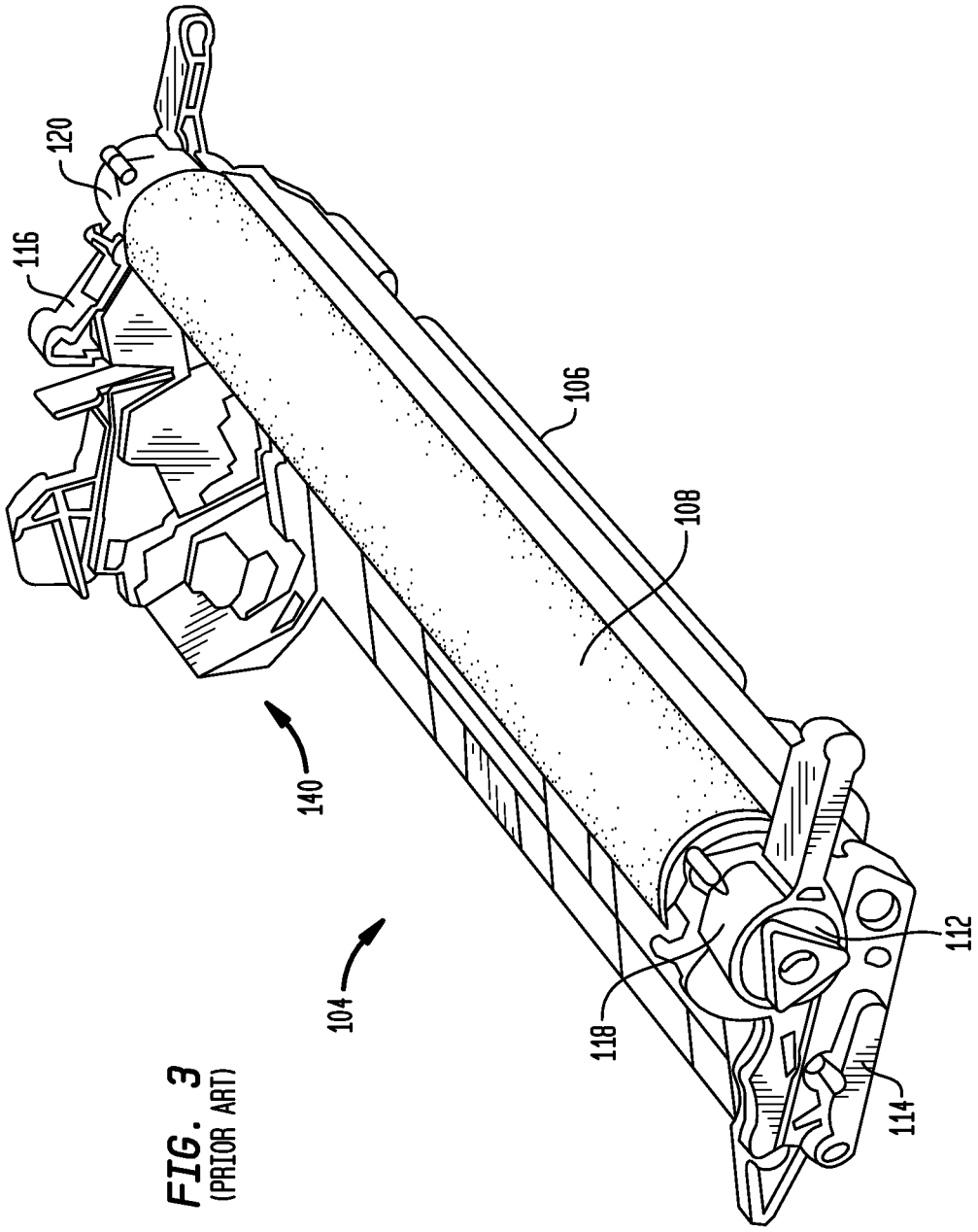

FIG. 3
(PRIOR ART)

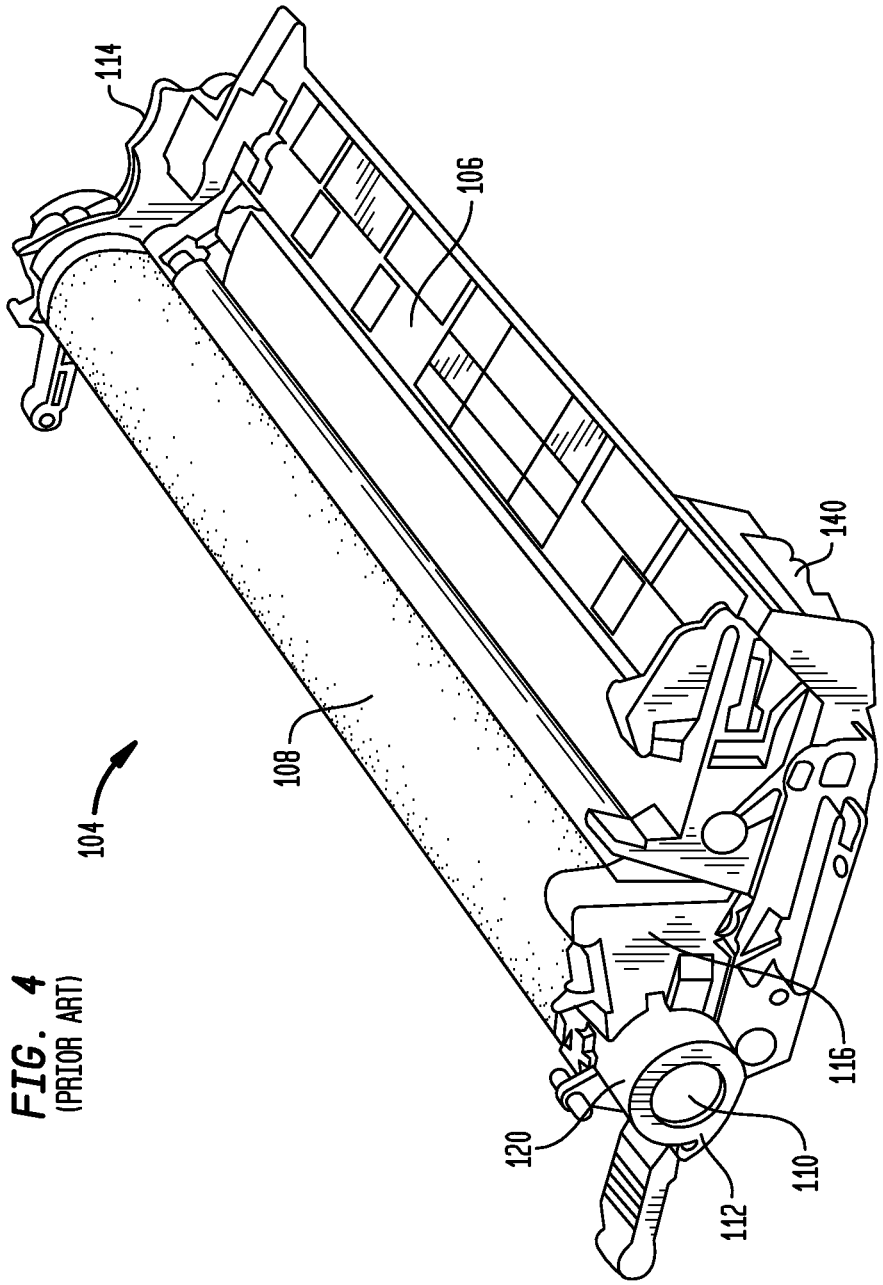

FIG. 4
(PRIOR ART)

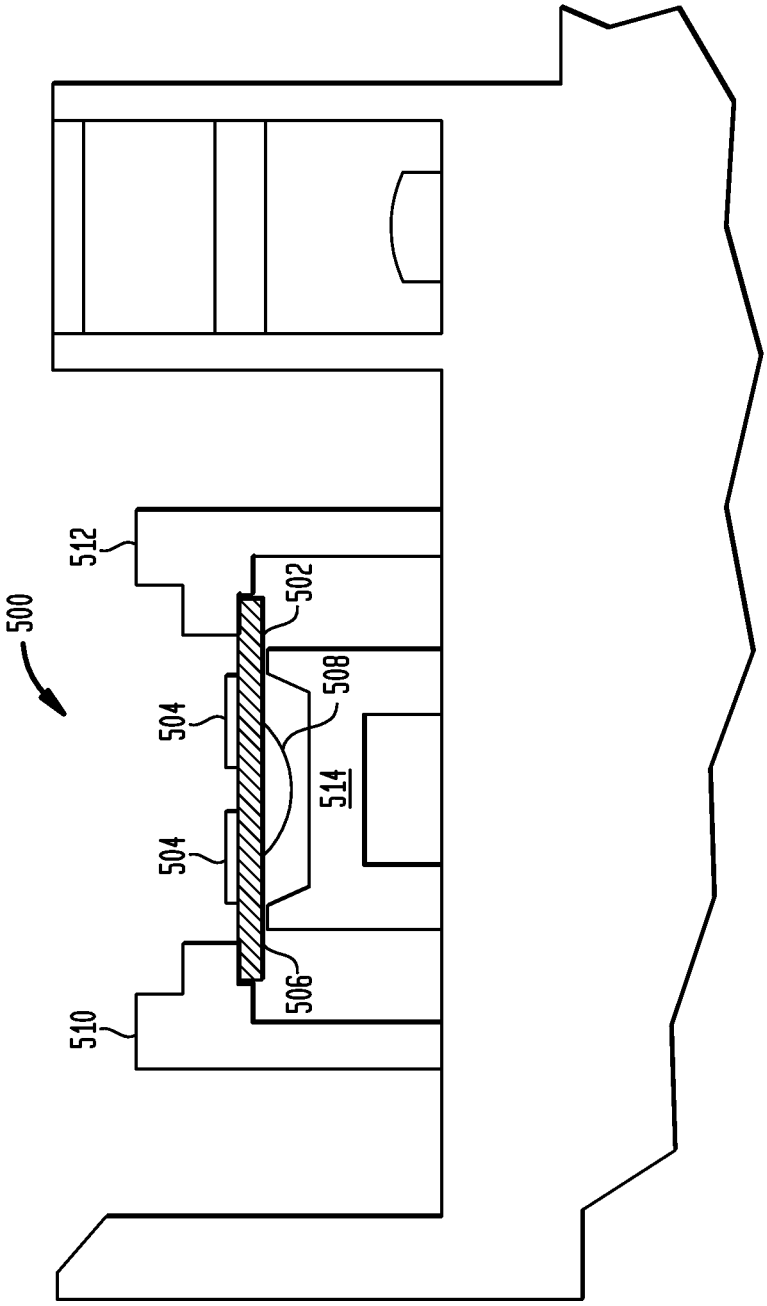

FIG. 5
(PRIOR ART)

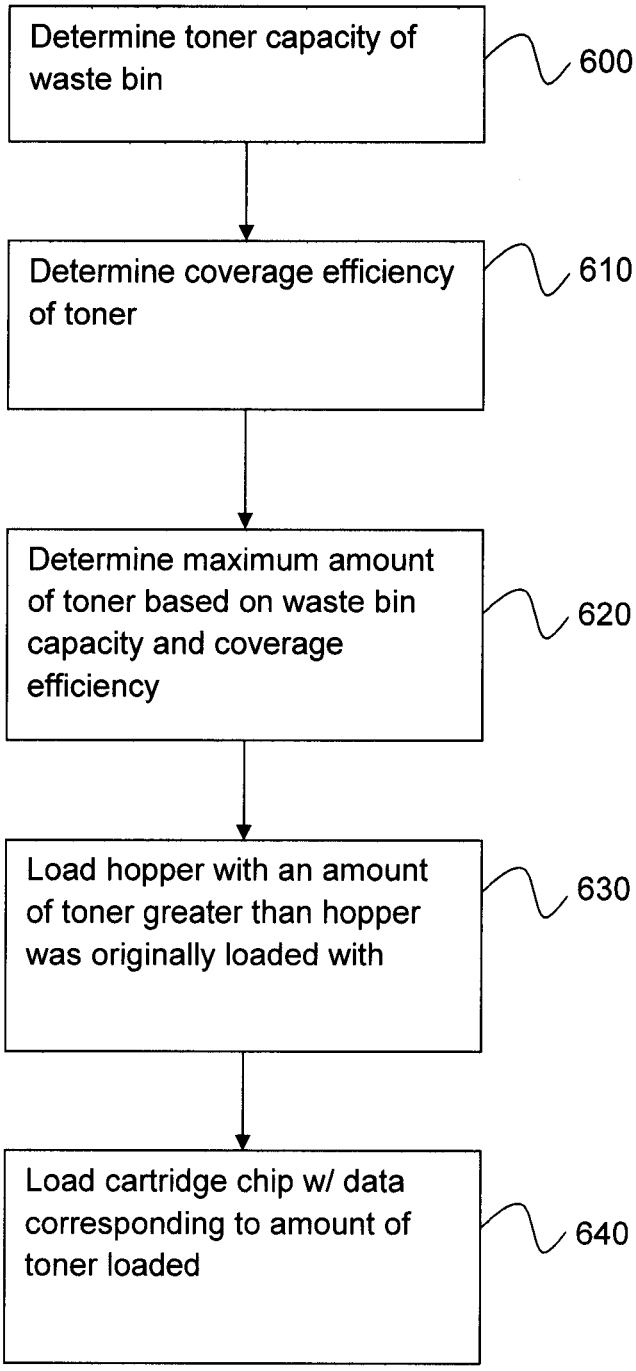
Determine toner capacity of waste bin
600
Determine coverage efficiency of toner
610
Determine maximum amount of toner based on waste bin capacity and coverage efficiency
620
Load hopper with an amount of toner greater than hopper was originally loaded with
630
Load cartridge chip w/ data corresponding to amount of toner loaded
640

FIG. 6

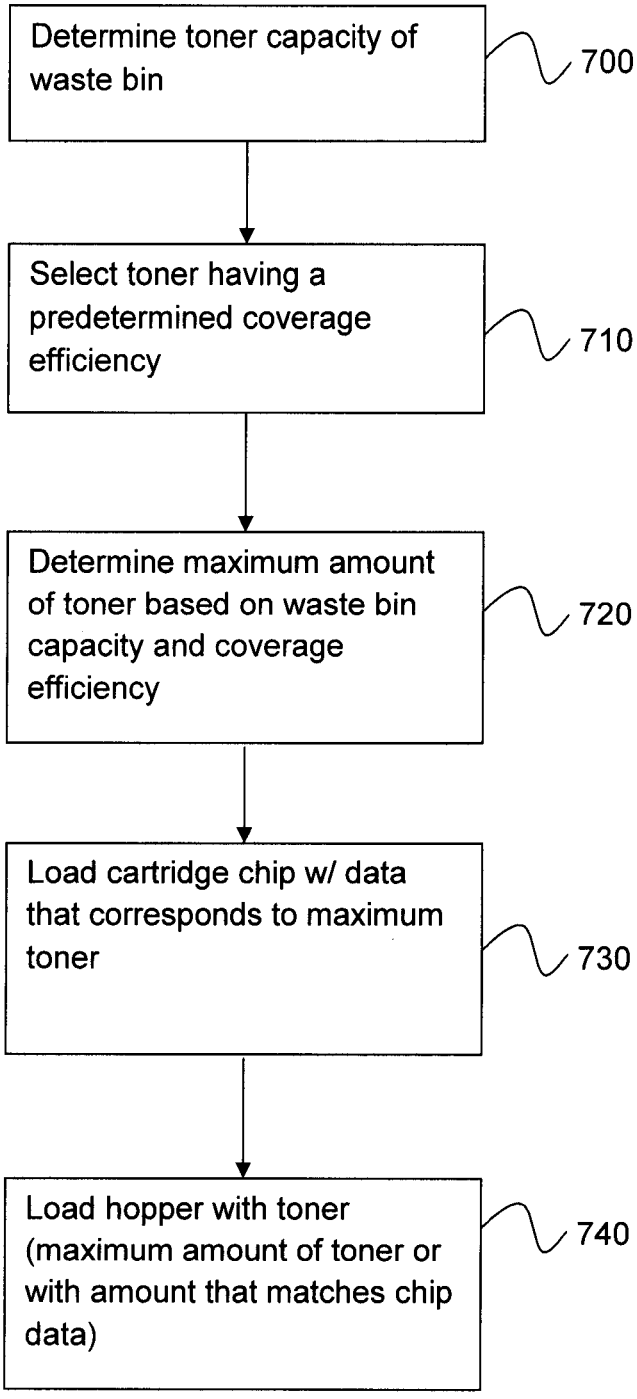
Determine toner capacity of waste bin
700
Select toner having a predetermined coverage efficiency
710
Determine maximum amount of toner based on waste bin capacity and coverage efficiency
720
Load cartridge chip w/ data that corresponds to maximum toner
730
Load hopper with toner (maximum amount of toner or with amount that matches chip data)
740

FIG. 7

REFILLED TONER CARTRIDGE HAVING INCREASED YIELD

BACKGROUND

Image recording devices, such as laser printers, use a replaceable cartridge containing a recording material to record an image on a recording medium.

Electrostatic or laser printers form an image on a recording medium by transferring toner particles onto the medium. Typically, a recording drum is charged and a latent image is formed on the drum by a laser. The latent image is developed on the drum by developer or toner particles and this image is transferred directly or indirectly onto a recording medium. In color printers multiple cartridges are provided to transfer color images.

A print cartridge often includes a memory device. This memory device may be loaded with information indicative of the cartridge parameters. When the printer detects that a new cartridge has been installed, the printer reads the information from the memory device. This information can be used to calibrate the operation of the printing device based upon the cartridge parameters. Often, the memory device includes information related to the cartridge capacity. The printer may read the cartridge capacity and print a status page telling the user information about the cartridge. The status page may include information such as manufacture date, cartridge type, and estimated page count for the cartridge.

The information stored in the memory may also be used to monitor the print life of the cartridge. One method of monitoring usage of a print cartridge is to count the amount of printing that is performed. In an electrostatic printer a counter may count the number of lines or pages printed by each cartridge. Each of the numbers counted is then processed as a count signal and the printer sends each of the count signals to the appropriate cartridge. The cartridge contains a memory that stores an initial value indicative the amount of printing agent contained in the cartridge. The printer uses the initial value and the number of pages or lines printed to determine a remaining life of the cartridge. When the cartridge gets to a low level, the printer may warn an operator to replace the cartridge and eventually prevent the cartridge from being used.

A used print cartridge contains many parts that have a useful life after the first use. It is desirable to refill or remanufacture these used print cartridges. This provides a less expensive alternative than purchasing new print cartridges, and reduces waste. When refilling a print cartridge, it is advantageous to provide a cartridge that has an increased print life. In an ink jet printer, the print life can be increased by adding more ink than cartridge was originally filled with or by using ink that has a higher print efficiency. In a laser printer, the print life can be extended by filling the cartridge with additional toner or by using toner that has an increased print efficiency.

When it is desired to provide a higher yield cartridge, it is necessary to change the initial value stored in the memory. If a cartridge has the capacity to record and increased number of pages and the initial value does not reflect this increased capacity, the printer may prevent the cartridge from realizing its full print life. Also, if the information stored in the memory does indicate an increased print capacity, the status page printed will not reflect the proper page count.

Therefore, on object of the invention is to provide a high yield print cartridge that displays the proper information on the status page and that prints until the cartridge is empty, or almost empty, of recording material.

SUMMARY

The present method and system allows a refilled print cartridge to provide a high yield print cartridge. A high yield print cartridge is a print cartridge that is capable of printing more sheets than standard yield print cartridge.

In one aspect of the application, the method includes refilling a toner cartridge having a waste bin, a hopper, and a cartridge chip, the cartridge chip includes a memory that stores information indicative of an initial amount of toner loaded in the toner cartridge, wherein a size of the waste bin limits a maximum amount of toner that may loaded into the hopper. The method includes determining a toner capacity of the waste bin, determining a coverage efficiency of a toner to be loaded in the hopper, and determining a maximum amount of toner that the hopper can be loaded with, wherein the maximum amount of toner is determined based on the toner capacity of the waste bin and the coverage efficiency of the toner. The hopper is loaded with a new amount of toner that is greater than an amount of toner that was originally loaded in the hopper by the original manufacturer. A replacement cartridge chip is provided and the replacement cartridge chip includes a memory that contains information indicative of the new amount of toner.

In another aspect the method includes refilling a toner cartridge having a waste bin, a hopper, and a cartridge chip, the cartridge chip includes a memory that stores information indicative of an initial amount of toner loaded in the toner cartridge, wherein a size of the waste bin limits a maximum amount of toner that may be loaded into the hopper. The method includes determining a toner capacity of the waste bin, selecting a toner to be loaded into the hopper, wherein the selected toner has predetermined coverage efficiency, and determining a maximum amount of toner that the hopper can be loaded with, wherein the maximum amount of toner is determined based on the toner capacity of the waste bin and the coverage efficiency of the toner. The hopper is loaded with a new amount of toner that is greater than an amount of toner that was originally loaded in the hopper by the original manufacturer. A replacement cartridge chip having a memory that contains information indicative of the new amount of toner is provided on the toner cartridge.

In another aspect the method includes refilling a toner cartridge having a waste bin, a hopper, and a cartridge chip. The method includes providing a replacement toner that has one or more characteristic and filling the hopper with a quantity of replacement toner. A cartridge life is determined based upon the quantity of replacement toner and the toner characteristic. The information indicative of an initial amount of toner loaded is updated in the cartridge chip memory based on the determined cartridge life.

In one aspect of the present application a toner cartridge is for use in an image forming apparatus. The toner cartridge includes a waste bin having a toner capacity, a hopper having a toner capacity, and a cartridge chip. The hopper is initially loaded with a toner having a coverage efficiency and the cartridge chip has a memory for storing information indicative of an amount toner loaded in the hopper. The hopper has a greater toner capacity than the waste bin and the hopper is loaded with an amount of toner based upon the capacity of the waste bin and the toner coverage efficiency.

In another aspect a refilled toner cartridge is for use in an image forming apparatus. The refilled toner cartridge has a waste bin having a toner capacity, a hopper having a toner capacity, and a cartridge chip having a memory for storing information indicative of an initial amount loaded in the hopper. The hopper is loaded with a quantity of replacement toner

having at least one characteristic that is different than a characteristic of a toner originally loaded in the toner cartridge. The information indicative of an initial amount toner is changed based upon the at least one characteristic of the replacement toner.

In another embodiment, the "cartridge" is not a print cartridge but another element in the device that has a finite amount use. For example, printers use rollers to feed a recording medium through the print zone. The rollers may work by using friction to force the recording medium through the printer. The surface of the rollers is often a material like plastic or rubber that wears out through the life of the printer.

These and other features and objects of the invention will be more fully understood from the following detailed description of the embodiments, which should be read in light of the accompanying drawings.

In this regard, before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein, as well as the abstract, are for the purpose of description and should not be regarded as limiting.

As such, those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be used as a basis for designing other structures, methods, and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of the specification, illustrate embodiments of the present invention and, together with the description, serve to explain the principles of the invention:

FIG. **1** illustrates a perspective view of the drive side end of a prior art toner cartridge;

FIG. **2** illustrates a perspective view of the non-drive side end view of a prior art toner cartridge;

FIG. **3** illustrates a perspective view of a waste bin assembly;

FIG. **4** illustrates a perspective view of a waste bin assembly;

FIG. **5** illustrates a cross-sectional view of a chip holding structure of a prior art toner cartridge;

FIG. **6** illustrates a method of filling a toner cartridge;

FIG. **7** illustrates another method of filling a toner cartridge.

DETAILED DESCRIPTION OF THE DRAWINGS

In imaging and printing devices, page counts recorded by non-volatile memory modules ("memory modules") may be incremented as pages are printed. Page counts may include the total number of pages printed by a printer and the total number of pages printed for each of a number of print categories. Recording the number of pages for individual print categories permits the recording of page counts for specific types of printing tasks, such as the total number of color pages, monochrome pages, letter size pages, legal size pages, transparencies, etc., that may be printed. In addition to recording page counts, non-volatile memory modules may be packaged with reservoirs such as ink or toner cartridges, and the memory modules may contain one or more fields for recording the depletion of the reservoirs. It will be appreciated by one of ordinary skill in the art that imaging and printing devices may contain non-volatile memory modules that have one or more counts, resource bit fields, or a combination thereof.

FIGS. **1** and **2** show perspective views of a prior art toner cartridge **100**. The toner cartridge **100** includes, among other components, a toner hopper assembly **102** and a waste bin assembly **104**. FIGS. **3** and **4** show perspective views of the waste bin assembly **104** after separation from the toner cartridge **100**. The waste bin assembly **104** includes a waste bin **106**, an organic photo conductor (OPC) drum **108**, and a chip holding structure **140**, described in greater detail below. The OPC drum **108** comprises a cylindrical tube having first and second hubs **110** and **112**, with each hub **110** and **112** extending from an end of the OPC drum **108**. The OPC drum **108** is held in place by a drive side end cap **114** and a non-drive side end cap **116** which include OPC retaining members **118** and **120**, respectively. The OPC retaining members **118** and **120** each include cylindrical openings which engage and hold the ends of the hubs **110** and **112** during the rotation of the OPC drum **108**. The cylindrical opening of the OPC retaining member **120** is narrowed at the end by a flange **122**.

FIG. **5** shows a cross-sectional view of a chip holding structure **500** of a prior art toner cartridge holding an OEM chip **502**. The OEM chip **502** may include electrical contacts **504** on one side of a printed circuit board (PCB) **506** for engagement with the printer and circuitry **508** including a memory element on the opposing side. Plastic flanges **510** and **512** hold the OEM chip from the top and the sides while support member **514** supports the bottom of the chip **502**. The support member **514** and the flanges **510** and **512** form a slot in which the chip **502** is inserted for attachment to the toner cartridge.

The OEM chip **502** includes a memory element that stores data related to the toner cartridge. The data may include manufacturer date, manufacturer name, cartridge parameters, toner type, toner amount, and any other desired information. When the cartridge is initially inserted into the printer, the printer electronically communicates with the chip. The communication may be used to authenticate that the cartridge is a proper cartridge, i.e. a cartridge that is made by the OEM and designed to work with the particular printer. The printer may also read the data from the memory that is indicative of the toner parameters, including the toner load. The printer then calculates an expected page life for the cartridge, that is the number of pages that cartridge should be able to record without running out of toner. The printer can print a status page that indicates whether the cartridge is authorized for use and the expected page life of the cartridge.

The printer also uses the data in the memory to determine an amount of toner left in the cartridge. The printer includes a counter that counts the number of sheets recorded or the number of pixels recorded. When the number of sheets recorded approaches the expected page life for the cartridge the printer indicates that the toner is low. The printer may eventually determine that the cartridge should be out of toner and disables printing. Alternatively, the printer may include a toner a sensor, a light pipe, or some other mechanism for determining the actual level of toner remaining in the cartridge. This toner detector can be activated when the toner count approaches the expected page life of the cartridge.

While a toner cartridge has been described, the above situation is applicable to any type of printer. For example, an ink

jet printer has an ink cartridge that includes an integral ink tank or an ink cartridge connected to a separate ink tank. The ink cartridge (or separate ink tank) includes a memory storing information such as the ink type, printer authentication data, and ink amount. This information is used to authenticate the ink cartridge and to determine a printing capacity for the ink cartridge.

Often, the OEM often does not fill the print cartridge with a maximum amount of recording material that the cartridge can hold. This is done for a number of reasons. One reason is that printers often come with an OEM print cartridge that has less recording material than a replacement print cartridge. A second reason is that certain other cartridge or printer parameters may limit the amount of recording material. For example, in toner cartridges, often the capacity of the waste bin is lower than the capacity of the hopper. In order to ensure that the waste bin does not overflow, the OEM fills the hopper below capacity. A third reason is for color cartridges. Typically color cartridges are used less than black cartridges and the OEM will fill color cartridges less to ensure that replacement cartridges are purchased regularly.

It is desirable to refill or remanufacture used print cartridges. Refilled print cartridges offer a more affordable replacement cartridge while maintain print quality and reduce waste. It is often possible to increase the print capacity of the refilled print cartridge. The page capacity can be increased by filling the print cartridge with more recording material (e.g. ink or toner) than the cartridge was initially filled with.

Another way to increase the print capacity of the print cartridge is to use a more efficient recording material may be used which allows the same amount of recording material to record additional pages. For example, toner has an efficiency rating that describes how much of the toner is used to record the image. The higher the efficiency rating the toner has the more images that can be recorded using the toner. Also, the higher the rating the less toner is wasted to be captured in the waste bin. In one embodiment, the toner cartridge is loaded with a toner having an efficiency of 75% or greater. In another embodiment the cartridge is loaded with a toner having an efficiency of 85% or greater.

Another way to increase the print yield of a print cartridge is to enlarge components of the print cartridge. For example, in a toner cartridge the size of the waste bin can be increased to allow the waste bin to hold more toner. In any type of printer, the size of the recording material tank (e.g. ink tank or hopper) may be increased.

Another way to increase the print yield of a print cartridge is to improve the efficiency of its components. For example, in a toner cartridge improving the doctor blade, the doctor blade gap, the PCR, the developer roller, the OPC, the supply roller, or the toner, may improve the cartridge yield. In an ink jet printer, improving the nozzles, the ejector mechanism, the ink, or the ink tank, may improve the cartridge yield.

Typically the OEM writes information in the memory that prevents the cartridge from being reused after the cartridge is used. Thus, often a refilled print cartridge needs a replacement print chip in order to work. When the print cartridge has increased print capacity the memory must indicate this in order to ensure that print cartridge will work for its full life.

FIG. **6** illustrates one method of refilling a toner cartridge. The method includes determining a storage capacity or limit of the waste bin **600**. The coverage efficiency of the toner is determined **610**. A maximum amount of toner that can be loaded into the toner hopper is determined based upon the waste bin capacity, the hopper capacity, and the efficiency of the toner **620**. The toner hopper is loaded with an amount toner that is greater than the amount the cartridge was initially loaded with but not greater than the determined maximum amount of toner **630**. The memory of the cartridge chip is loaded with data related to the amount of toner loaded in the cartridge. This method gives a toner cartridge having an increased print yield that will work properly in the OEM printer.

FIG. **7** illustrates another method of refilling a toner cartridge. The method includes determining the toner capacity of waste bin **700**. A toner having a predetermined coverage efficiency is selected **710**. A maximum amount of toner based on waste bin capacity and coverage efficiency **720** is determined. The cartridge chip is loaded with data that corresponds to the determined maximum toner amount **730**. The hopper is loaded with the maximum amount of toner **740**. Alternatively the cartridge chip can be loaded with data that corresponds to a toner amount that is less than the maximum amount of toner and the hopper is loaded with an amount of toner that matches the data.

Using one of the methods above results a refilled toner cartridge. The toner cartridge has a waste bin having a toner capacity, and a hopper having a toner capacity. The hopper was initially loaded with a toner having a coverage efficiency. The cartridge has a cartridge chip including a memory for storing information indicative of an amount toner loaded in the hopper. The hopper has a greater toner capacity than the waste bin and the hopper is loaded with an amount of toner based upon the capacity of the waste bin and the toner coverage efficiency.

Another method for increasing the yield of a print cartridge will now be described. There is an expected life (or print yield) for a print cartridge based upon the amount of recording medium loaded into the cartridge. However, dependent upon various factors, the print cartridge may run out of recording material before or after the expected yield has been met. If the print cartridge runs out of recording material after the expected yield the cartridge is removed while still maintaining recording material. If the cartridge runs out of recording material before the expected yield, it is possible that the cartridge will stop printing in the middle of the print job. Also, in ink jet printers, it can damage the recording head to try and print when there is no ink available. Therefore, the OEM typically sets the data in the memory so that the toner or ink level will outlast the empty cartridge warning.

In order to increase the yield the cartridge, the data in cartridge chip memory can be set to more closely match the predicted yield of the print cartridge. Therefore, there will be less recording material remaining in the print cartridge when the printer indicates that the print cartridge is out of recording material.

The methods and apparatuses described above may also be used in managed print system (MPS). A managed print system is a system where all of the devices of an entity are monitored and maintained by a single party. Typically, a third party vendor or information technology person uses software to monitor a network of devices, including printers, copiers, scanners, facsimile machines, and scanners. The MPS can route jobs and results throughout the network to ensure the most efficient use of resources. The MPS also monitors the status of equipment and maintains the equipment. For example, the MPS provider is able to monitor the remaining life in print cartridges, paper use, and other maintenance related information.

The MPS uses software to manage the network of peripheral devices. The MPS can operate the printers and direct the printer to look for a code stored in the memory of the cartridge chip. This allows for the memory of a replacement chip to contain additional information than the OEM chip, without

inhibiting the operation of the chip. When the code is detected, the MPS provider determines that the printer is loaded with a high yield cartridge. The MPS system is able to accurately track the amount of recording material left in the cartridge and order a replacement cartridge at the proper time. The MPS can either update the individual printers with the accurate information or allow the individual printers to have inaccurate status information.

The many features and advantages of the invention are apparent from the detailed specification. Thus, the appended claims are intended to cover all such features and advantages of the invention which fall within the true spirits and scope of the invention. Further, since numerous modifications and variations will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation illustrated and described. Accordingly, all appropriate modifications and equivalents may be included within the scope of the invention.

Although this invention has been illustrated by reference to specific embodiments, it will be apparent to those skilled in the art that various changes and modifications may be made which clearly fall within the scope of the invention. The invention is intended to be protected broadly within the spirit and scope of the appended claims.

What is claimed is:

1. A toner cartridge for use in an image forming apparatus, the toner cartridge comprising:

a waste bin having a first toner capacity;

a hopper having a second toner capacity, wherein the hopper is initially loaded with an actual amount of toner having a toner coverage efficiency, and the actual amount of toner is greater than an amount of toner that the cartridge was originally loaded with; and

a cartridge chip including a memory for storing information indicative of an amount of toner loaded in the hopper, wherein the second toner capacity is greater than the first toner capacity and the hopper is loaded with the actual amount of toner based upon the first toner capacity of the waste bin and the toner coverage efficiency, wherein the actual amount of toner having the toner coverage efficiency results in an amount of waste toner that will not overfill the waste bin.

2. The toner cartridge of claim **1** wherein the toner cartridge is a refilled toner cartridge.

3. The toner cartridge of claim **2** wherein the memory stores information indicative of the actual amount of toner loaded in the cartridge.

4. The toner cartridge of claim **2** wherein the toner cartridge is refilled to a maximum amount of toner determined by the first toner capacity of the waste bin and the toner coverage efficiency.

5. The toner cartridge of claim **2** wherein the toner cartridge is refilled with the actual amount of toner that is greater than 75% of the second toner capacity of the hopper.

6. The toner cartridge of claim **2** wherein the toner cartridge is refilled with the actual amount of toner that is greater than 85% of the second toner capacity of the hopper.

7. The toner cartridge of claim **2** wherein the waste bin is modified to increase the first toner capacity.

8. The toner cartridge of claim **2** wherein the waste bin is replaced by a replacement waste bin, wherein the replacement waste bin has a larger toner capacity than the waste bin.

* * * * *